

## PATENT SPECIFICATION (11)

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## (54) MATERIAL AND YARN FOR MAKING SAME

(71) I, ROBERT MICHAEL BYRNES, a Citizen of the United States of America, of 6720 North 16th Street, Omaha, Nebraska, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The present invention generally relates to material and to yarn for use in making material.

15 In U.S. Patent No. 3,883,898 the use of aromatic polyamide fibre, such as Kevlar (Registered Trade Mark) in making protective gloves and garments is disclosed. U.S. Patent No. 3,953,893 relates to a protective apron constructed from this material.

20 U.S. Patent No. 4,004,295 discloses the combination of flexible metal wire strands and flexible aromatic polyamide fibre yarn strands in the construction of woven, non-woven or knitted gloves from these materials. While the Kevlar material by itself  
 25 or used in combination with flexible wire strands is successful for many applications, an improved yarn and fabric are desirable for certain usages.

30 According to one aspect of this invention there is provided a yarn characterised in that it consists of a core and a covering, the said core including or consisting of a flexible annealed wire having a diameter not exceeding 0.01 inches and the covering comprising at least one strand of aromatic polyamide fibre wrapped on the exterior of the core.

40 According to another aspect of the invention there is provided a material constructed of yarn consisting of a core and a covering, the said core including or consisting of a flexible annealed wire having a diameter not greater than 0.01 inches, and the covering comprising at least one strand of aromatic polyamide fibre wrapped on the exterior of the core.

45 The invention also includes articles of clothing including such material, for example a protective glove.

50 The invention may be performed in

various ways and embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Fig. 1 is a plan view of a protective glove constructed of yarn having a flexible core; and

Fig. 2 is an elevational view, on an enlarged scale, illustrating the structure of the yarn and the manner in which cover fibres are wound on the flexible core.

The drawings illustrate a finished protective glove 10 which is exemplary of a garment or the like constructed from the yarn 12 in which conventional techniques and glove making machinery are employed to form a glove having the usual finger stalls 14, thumb stall 16, front panel 18, rear panel 20 and wrist cuff 22.

The yarn 12 is constructed of a flexible metallic annealed wire 24 and a strand 25 of flexible aromatic polyamide fibre, such as a spun strand or filament strand, which form a core. The core is wrapped spirally with two strands 26 and 28 of an aromatic polyamide fiber, such as "Kevlar", in which one strand is wrapped clockwise around the core and the other strand is wrapped counter-clockwise around the core. The filament core strand 25 may have a denier ranging from 200 to 1500 with the preferred denier range being from 200 to 400 with the fiber strands being in the form of a monofilament and substantially free of twist. When a spun aromatic polyamide fiber core strand 25 is used, it may have a cotton count ranging from 1 to 60 with the preferred range being 15 to 35 and an ideal cotton count of 25. The core wire 24 is in the form of a flexible wire such as stainless steel, malleable iron, copper, aluminium or other flexible, malleable, totally annealed metallic wire having a diameter ranging between 0.004" and 0.006" plus or minus 0.0005" with no minimum and a maximum of 0.01". The cover strands 26 and 28 may be either of aromatic polyamide fibers spun as in cotton processes or of continuous aromatic polyamide filaments with each filament having denier ranging from 200 to 1500 with the

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preferred denier being 200 to 400, and with the spun strands having a cotton count from 1 to 60 with the preferred range from 15 to 35 and the ideal being 25. However, it is presently preferred to use spun fiber strands for cover strands 26 and 28.

The yarn 12 may be used with standard needles such as employed in glove knitting machines and may be used with various types of standard machines employed in forming fabrics such as by weaving or knitting. Also, the yarn may be employed for various purposes where long lasting and high strength characteristics as well as high cut resistance is desired. It has been found that fabric formed by the yarn exhibits in certain applications a far superior cut resistance and point penetration resistance than similar material made from aromatic polyamide fiber alone.

The dimensional characteristics of the core strands may vary depending upon the ultimate use of the yarn. The above dimensions have been found critical when forming protective gloves especially adapted for use by persons gripping or handling items having sharp edges or pointed ends or using sharp or pointed items in various work procedures. For example, the gloves may be employed in meat processing plants where sharp knives are used, in glass manufacturing operations where sheet glass or the like is handled, in sheet metal making or forming operations where edges of sheet metal are handled and in many other uses where high cut resistance is desired. The yarn may be employed for various other items wherever natural, synthetic or metallic yarn is presently used with the properties of the core and the aromatic polyamide fiber covering cooperating to produce a yarn having extremely high tensile strength and resistance to cutting when formed into a fabric but yet the yarn can be utilized in standard machines which handle various natural, synthetic or metallic fibers. The fiber covering facilitates movement of the yarn when making various items and provides substantial additional strength. When a small weave fabric is made, more resistance to penetration of a knife point is provided. The core strand of aromatic polyamide fiber cushions the yarn and increases the flexibility thereof.

The advantages of this glove over a conventional wire mesh or wire ring glove include its increased strength, resistance to breakage, resistance to absorption of moisture, lack of skin irritation, lightweight characteristics, flexibility, cleanability and insulation characteristics. The glove is safer as it will slip off the hand if caught on some moving machine while the mesh glove cannot since it is buckled in place. The elasticity of the glove enables better fit and the flexibility provides better feel and more secure

gripping of workpieces and tools. The glove is more comfortable and is used on either hand whereas metal mesh gloves are either left or right handed. The glove provides insulation against both cold and heat, has a significant weight advantage, weighing about 2 oz., compared to about 12 to 14 oz. for a metal mesh glove. The glove also can be sterilized when used in food handling and can be readily constructed on existing machines while the metal link glove is usually hand formed from link sheets.

The advantages over the glove disclosed in U.S. Patent No. 3,883,898 include better machine handling of the yarn, increased resistance to point penetration since the knitted or woven stitch does not elongate as much when stressed, and improved cut resistance by preventing excessive stress of the aromatic polyamide fibres over the knuckles when a fist is formed.

In heavy duty uses, such as in cables, where multiple yarn strands may be employed, the aromatic polyamide core strand 25 may be omitted and a single wire core 24 having a diameter up to 0.01" may be used.

It will be appreciated that the flexibility of the yarn as well as the dimensional characteristics and other physical characteristics thereof are maintained within limits enabling the yarn to be utilized in standard yarn handling and processing machinery such as glove forming machinery or machinery for forming various fabrics and garments as well as other items.

#### WHAT I CLAIM IS:—

1. A yarn characterised in that it consists of a core and a covering, the said core including or consisting of a flexible annealed wire having a diameter not exceeding 0.01 inches and the covering comprising at least one strand of aromatic polyamide fibre wrapped on the exterior of the core.

2. A yarn as claimed in Claim 1 in which the core includes at least one strand of aromatic polyamide fibre laid alongside the wire.

3. A yarn as claimed in Claim 1 or 2 in which the wire is stainless steel and has a diameter ranging between 0.004 inches to 0.006 inches plus or minus 0.0005 inches.

4. A yarn as claimed in Claim 1 or 2 in which the core fibre strand is a filament strand having a denier size ranging from 200 to 1500.

5. A yarn as claimed in Claim 4 in which the core fibre strand is a filament having a denier size ranging from 200 to 400.

6. A yarn as claimed in Claim 1 or 2 in which the core fibre strand is spun and has a cotton count between 1 and 60.

7. A yarn as claimed in Claim 6 in which the cotton count is between 15 and 35.

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8. A yarn as claimed in Claim 6 in which the cotton count is 25.
9. A yarn as claimed in Claim 1 in which the aromatic polyamide fibre wrapping comprises two strands of filament fibre the denier of the filament fibre ranging between 200 and 1500.
10. A yarn as claimed in Claim 9 in which the denier range is from 200 to 400.
11. A yarn as claimed in Claim 1 in which the wrapping comprises two strands of spun aromatic polyamide fibres, each strand having a cotton count between 1 and 60.
12. A yarn as claimed in Claim 11 in which the cotton count is between 15 and 35.
13. A yarn as claimed in Claim 11 in which the cotton count is 25.
14. A yarn as claimed in any one of Claims 1 or 9 to 13 in which there are two wrapping strands wound onto the exterior of the core, one of the strands being wound in a clockwise direction and the other of the strands being wound in a counter-clockwise direction.
15. A yarn as claimed in any one of Claims 1 to 3 in which the core consists of a single strand of flexible totally annealed wire having a diameter of 0.0065 inches.
16. A yarn substantially as hereinbefore described with reference to Fig. 2 of the accompanying drawings.
17. A material constructed of yarn consisting of a core and a covering, the said core including or consisting of a flexible annealed wire having a diameter not greater than 0.01 inches, and the covering comprising at least one strand of aromatic polyamide fibre wrapped on the exterior of the core.
18. A material as claimed in Claim 17 wherein the core of the yarn consists of at least one strand of aromatic polyamide fibre laid alongside the wire.
19. A material as claimed in Claim 17 in which the wrapping of the core consists of strands of aromatic polyamide fibre all of filament form and each having a denier lying in the range 200 to 1500.
20. A material as claimed in Claim 17 in which the wrapping of the core consists of strands of aromatic polyamide fibre of spun form each strand having a cotton count between 1 and 20.
21. A material as claimed in any one of Claims 17 to 20 in which the wire is stainless steel having a diameter ranging between 0.004 inches to 0.006 inches plus or minus 0.0005 inches.
22. A material as claimed in any one of Claims 17 to 20 in which there are two strands of aromatic polyamide fibre wound on the exterior of the core, one of said strands being wound in a clockwise direction and the other of the strands being wound in a counter-clockwise direction, the said wire strand of the core having a diameter not greater than 0.01 inches.
23. A material as claimed in Claim 17 in which the core also includes a strand of aromatic polyamide fibre extending alongside of and in contact with the wire the fibre core strand having a cotton count between 1 and 60, the covering including two strands of aromatic polyamide fibre wrapped in opposite directions and completely encasing the core, the covering strands of fibre being spun fibre having a cotton count between 1 and 60.
24. A material as claimed in Claim 17 in which the core also includes a strand of aromatic polyamide fibre extending alongside of and in contact with the wire, the fibre core strand being a filament fibre having a denier range between 200 and 1500, said covering including two strands of aromatic polyamide fibre wrapped in opposite directions and completely encasing the core, the covering strands of fibre being filament fibre having a denier range between 200 and 1500.
25. A material as claimed in any one of Claims 17 to 24 when produced substantially as hereinbefore described.
26. A protective glove constructed of yarn as claimed in any one of Claims 1 to 15.
27. A protective glove substantially as hereinbefore described with reference to and as illustrated in Fig. 1 of the accompanying drawings.

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1586890 COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
the Original on a reduced scale*

Fig. 1

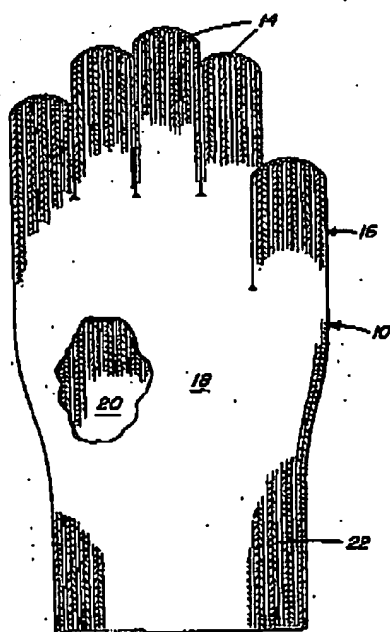


Fig. 2

